CORRUGATED PRODUCT

FIELD OF THE INVENTION

The invention relates to a corrugated product, comprising at least one first substantially plane sheet and at least one second sheet arranged in wave shape. The first sheet is joined with the second sheet in joining areas, forming a framework shape having the joining areas arranged at tops of the second sheet.

PRIOR ART

The industrialization of the world has led to, and continuously leads to, increased transports and increased handling of products. This together with a focus on decreased cassation increases the demands on load carriers as well as on product protection intended to manage an increased handling and longer transport distances. The solution to this problem is often to use more rigid and more sophisticated packages and packing to protect the products. To accomplish this, the material content in the packages is increased or exchanged to a more durable packaging material. This leads to increased packing costs and environmental influence. One example of a common packing material of today is corrugated fibreboard.

It is also known that sheets of plastic material can be formed to wave shape and that such wave shaped sheets can be connected with plane sheets of similar material. One example of this is shown and described in US-A-4897146. The corrugated material described in US-A-4897146 is suitable to be used as roof or wall panels, but is less suitable for other purposes, such as for packing and similar.

Another material showing good properties in connection with packing and transport is disclosed in WO0108878. WO0108878 discloses a corrugated material comprising a plurality of sheets of material, wherein at least a first plane sheet and a second wave shaped sheet of plastic material are connected to each other. For example, the corrugated material comprises

three layers, wherein one corrugated layer is arranged between two plane layers. Alternatively, the corrugated material comprises two interconnected and opposite corrugated layers, which can be arranged between two plane layers. WO0108878 also discloses different material compositions in the different sheets. For example, an aluminium foil or similar material can be used in some sheet or an intermediate layer can comprise extensive amounts of filler and the outer layers can comprise less filler, wherein a sheet material is provided that can resist higher load in the direction of the channels and simultaneously have very elastic outer layers. Further the corrugated sheet can be formed in a considerably thicker and stronger material than other layers to achieve more favourable characteristics concerning durability and impact resistance.

One drawback with this type of corrugated material of prior art is that the resistance, or strength of the material, not is satisfying. This can result in that packages and other packing as well as the products to be protected are damaged when transported or handled in another way. Also a smaller increase of the resistance leads to a substantial increase in consumption of material, which is a problem if increased demands on the material are to be met.

THE INVENTION IN SUMMARY

One object of the present invention is to reduce the problems and drawbacks of prior art packing materials. The corrugated product according to the invention makes it possible to, inter alia, obtain reduced consumption of material while maintaining the strength and resistance of the product, or increased strength and resistance while maintaining the consumption of material. This results in reduced costs and reduced environmental influence. Except increase in strength in relation to the consumption of material some embodiments provide an improved shock absorption, improved printability and improved piling stability.

According to the invention a corrugated product is provided that comprises a plurality of cooperating material sheets. A first substantially plane sheet is joined to at least one wave shaped second sheet. The substantially plane form of the first sheet renders it suitable as a delimiting wall in packing and packages. The wave shape of the second sheet shows marked tops and has, in cooperation with the first sheet, a favourable ability to absorb forces acting upon the tops.

In the area around the tops the second sheet is joined with the first sheet in joining areas. Together, the first sheet and the second sheet form a framework shape having favourable resistance characteristics, which are enhanced by that the first substantially plane sheet is arranged with a regular elevation between adjacent joining areas. The height of the elevations is substantially less than the height of the waves of the second sheet.

According to one embodiment of the invention a third sheet can also be joined with the second sheet, so that the first sheet and the third sheet is arranged on opposite sides of the second wave shaped sheet. The third sheet can be completely planar or show elevations corresponding to the ones of the first sheet. In further embodiments one additional wave shaped sheet is included, which suitably is arranged with its wave crests towards the wave crests of the second sheet.

The material sheets used can comprise different kinds of material. Examples of suitable base materials are fibre, plastic, plastic composite, chalk, paper and cellulose. For some applications and applications with specific demands concerning tightness, heat insulation capacity or durability against moisture, the material sheets can be arranged in a plurality of layers, wherein layers of plastic materials as polypropylene and polyethylene for example can be combined with layers of fibre, aluminium and other materials having suitable properties.

A corrugated product according to the invention provides, inter alia, increased strength in relation to the consumption of material in a load direction along the channels of the corrugated material. This is obtained through

that the elevations in the outer sheets between the joining areas provide the corrugated product with a larger total height and, consequently, a substantially increased surface inertia factor and strength.

SHORT DESCRIPTION OF THE DRAWINGS

The invention will now be described more in detail by embodiment examples, reference being made to the accompanying drawings, in which

Fig. 1 is a schematic side view of a corrugated product according to one embodiment of the present invention,

Fig. 2 is a schematic side view of a corrugated product according to one alternative embodiment of the present invention,

Fig. 3 is a schematic side view of a wave shaped second sheet,

Fig. 4 is a schematic side view of a wave shaped sheet arranged with a thinner portion in connection with the joining areas,

Fig. 5 is a schematic side view of a corrugated product comprising a substantially plane first sheet connected to a wave shaped second sheet,

Fig. 6 is a schematic side view of a corrugated product comprising a substantially plane first sheet connected to a wave shaped second sheet provided with thinner portions,

Fig. 7 is a schematic side view of a corrugated product comprising a substantially plane first sheet connected to a wave shaped second sheet provided with thinner portions according to an alternative embodiment of the present invention,

Fig. 8 is a schematic side view of a corrugated product comprising two substantially plane sheets connected to a wave shaped second sheet provided with thinner portions according to one embodiment of the present invention,

Fig. 9 is a schematic side view of a corrugated product comprising two substantially plane sheets connected to a wave shaped second sheet provided with thinner portions according to one alternative embodiment of the present invention,

Fig. 10 is a schematic side view of a corrugated product comprising three substantially plane sheets connected to two parallel wave shaped sheets provided with thinner portions,

Fig. 11 is a schematic side view of a corrugated product comprising two substantially plane sheets connected to two opposite wave shaped sheets provided with thinner portions,

Fig. 12 is a schematic cross section view illustrating one example of the composition of the sheets having a plurality of layers,

Fig. 13 is a schematic cross section view illustrating one additional example of the composition of the sheets having a plurality of layers,

Fig. 14 is a schematic cross section view illustrating one additional example of the composition of the sheets having a plurality of layers, and

Fig. 15 is a schematic view of a device for the manufacture of one embodiment of the corrugated product according to the invention.

THE INVENTION

Fig. 1 is a schematic side view of a corrugated product 10 according to one embodiment of the present invention. The corrugated product 10 comprises a substantially plane first sheet 11, a wave shaped second sheet 12 and a substantially plane third sheet 13. The sheets 11-13 are arranged substantially in parallel, wherein an extension of the sheets 11-13 corresponds to the extension or longitudinal direction of the corrugated material 10. Thus, the sheets 11-13 are arranged so that they extend in the longitudinal direction of the corrugated material 10, wherein tops 14, wave crests or similar of the wave shaped second sheet 12 are arranged across the longitudinal direction of the corrugated material 10.

The first sheet 11 and the third sheet 13 are connected to the wave shaped second sheet 12 in joining areas 15, wherein the wave shaped second sheet 12 is arranged between the first sheet 11 and the third sheet 13. Thus, the first sheet 11 and the third sheet 13 are joined with the second sheet 12 in joining areas 15 forming a framework shape having the joining areas 15 arranged at the wave tops 14 of the second sheet 12.

The first substantially plane sheet 11 and the third substantially plane sheet 13 are arranged with a regular elevation 16 between adjacent joining areas 15, wherein a strong corrugated material having favourable resistance properties and shock absorbing properties is obtained. Hence, the first sheet 11 and the third sheet 13 project from the wave shaped second sheet 12 between the joining areas 15. The elevations 16 are arranged with a height that is substantially smaller than the height of a wave of the second sheet 12. For example, the elevation is formed as an arc of a sector of a circle or similar.

Fig. 2 is a schematic side view of a corrugated product 10 according to an alternative embodiment of the present invention. The corrugated product 10 comprises the first sheet 11, the wave shaped second sheet 12 and the third sheet 13. In the embodiment of Fig. 2 the third sheet 13 is completely planar. Thus, in this embodiment of the invention the corrugated ma-

terial 10 comprises the first sheet 11 having regular elevations 16 between adjacent joining areas 15, the wave shaped second sheet 12 and a completely plane third sheet 13.

Fig. 3 illustrates the wave shaped second sheet 12 more in detail. In the embodiment of Fig. 3 the wave shaped second sheet 12 is arranged with an invariable thickness to obtain a regular wave shape. The wave shaped second sheet 12 thus comprises rounded tops 14 having intermediate bars 17 of the second sheet 12.

Fig. 4 illustrates the wave shaped second sheet 12 according to one additional embodiment of the present invention. In the embodiment of Fig. 4 the wave shaped second sheet 12 is arranged with a thinner portion 18 in connection with the joining areas 15. The wave shaped second sheet 12 thus comprises a thinner portion 18 between the bars 17 of the second sheet 12. The thinner portion 18 is arranged with a length and thickness that in combination with length and size of the remaining portions of the second sheet 12 and the inclination of the bars 17 results in substantially the same consumption of material and/or cross section area of the second sheet 12 as of a corresponding plane sheet without thinner portions of the same width.

For example, the distance between each top 14 of the second sheet 12 is substantially the same. It can also be suitable that the second sheet 12 is corrugated so that the angle between each bar 17 is about sixty degrees. However, it is obvious for a person skilled in the art that dimensions and angles can be modified according to the application.

By forming the wave shaped second sheet 12, or the corrugated intermediary sheet, with thinner portions 18 in the sections in which the wave shaped sheet 12 is joined to the other sheets, such as external outer sheets, a saving in material is obtained in the intermediary sheet. According to one embodiment the thinner portions 18, together with the angle and shape of the bars 17 of the wave shaped second sheet 12, can form a wave shaped sheet 12 that has the same consumption of material at the same width, i.e. cross section area, as a corresponding plane and non-corrugated intermedi-

ary sheet would have without the thinner portions 18. According to one additional embodiment the thinner portions 18 of the wave shaped second sheet 12 is joined to the outer sheets across the entire width of the thinner portion 18 and, also, with the ends or adjacent portions of the wider bars 17.

The bars 17 of the wave shaped second sheet 12 can be straight, which results in a higher strength of the wave shaped second sheet 12 than arched bars or a sinusoidal corrugation.

Fig. 5 is a schematic side view of a corrugated product 10 comprising the first sheet 11 connected to a wave shaped second sheet 12 having a regular or invariable thickness. For example, the first sheet 11 is connected with the second sheet 12 through a welded joint or similar, wherein the material of the first sheet 11 in the joining areas 15 is integrated with the material of the second sheet 12. Welding comprises melting of the sheets in the joining areas 15.

Fig. 6 is a schematic side view of a corrugated product 10 comprising the first sheet 11 connected to a wave shaped second sheet 12 having thinner portions 18. For example, the first sheet 11 is connected with the second sheet 12 through a welded joint or similar, wherein the material of the first sheet 11 in the joining areas 15 is integrated with the material of the second sheet 12.

Fig. 7 is a schematic side view of a corrugated product 10 comprising the first sheet 11 connected to a wave shaped second sheet 12 provided with thinner portions 18. For example, the first sheet 11 is connected with the second sheet 12 through a glued joint or similar, wherein the material of the first sheet 11 abuts the second sheet 12 in the joining areas 15.

Fig. 8 is a schematic side view of a corrugated product 10 comprising a substantially plane first sheet 11 and a substantially plane third sheet 13 connected to a wave shaped second sheet 12 provided with thinner portions 18 according to one embodiment of the present invention. In the embodiment of Fig. 8 the joining areas 15 between the first sheet 11 and the second

sheet 12 comprise the entire thinner portion 18 and a thicker portion of the second sheet 12 adjacent to the thinner portion 18.

Fig. 9 is a schematic side view of a corrugated product comprising a substantially plane first sheet 11 and a substantially plane third sheet 13 connected to a wave shaped second sheet 12 provided with thinner portions 18 according to one additional embodiment of the present invention. In contrast to the embodiment of Fig. 8 the joining areas 15 between the first sheet 11 and the second sheet 12 in Fig. 9 comprise only the thinner portion 18 of the second sheet 12.

Fig. 10 is a schematic side view of a corrugated product 10 comprising a substantially plane first sheet 11 connected to a wave shaped second sheet 12 provided with thinner portions 18. The second sheet 12 is further connected to a completely plane third sheet 13, which third sheet 13 is connected to a fourth wave shaped sheet 19. The fourth wave shaped sheet 19 is further connected to a substantially plane fifth sheet 20. The wave shaped second sheet 12 is arranged between the first sheet 11 and the third sheet 13 and the wave shaped fourth sheet 19 is arranged between the third sheet 13 and the fifth sheet 20. Thus, the first sheet 11 and the third sheet 13 are arranged on opposite sides of the second wave shaped sheet 12 and the third sheet 13 and the fifth sheet 20 are arranged on opposite sides of the fourth wave shaped sheet 19. The sheets 11-13, 19 and 20 are arranged in parallel. Hence, a corrugated product 10 is provided, comprising a framework shape according to one additional embodiment of the present invention.

Fig. 11 is a schematic side view of a corrugated product 10 comprising two substantially plane sheets connected to two opposite wave shaped sheets provided with thinner portions. Thus, a substantially plane first sheet 11 is connected to a wave shaped second sheet 12 provided with thinner portions 18. The second sheet 12 is connected to an opposite and wave shaped third sheet 13 having thinner portions 18, wherein the wave tops 14 of the second wave shaped sheet are connected with the wave tops of the

third wave shaped sheet 13. The third wave shaped sheet 13 is further connected to a fourth substantially plane sheet 35.

The corrugated material 10 and/or the different material sheets used can comprise different types of materials. Examples of suitable base materials are fibre, plastic, plastic composites, chalk, cellulose, paper or starch-based materials. Examples of plastic materials are polypropylene, polyethylene, polystyrene, PVC and similar. For applications with specific demands concerning tightness, heat insulation capacity or resistance to moisture one or more of the material sheets can be formed in a plurality of layers, wherein layers of plastic materials, such as polypropylene and polyethylene, can be combined with layers of fibre, aluminium and other materials or mixtures thereof having suitable properties.

At least the second sheet is, for example, formed in a thermoplastic material or a material comprising a thermoplastic or a compound thereof. The material in the sheets can then, for example, comprise a filler of chalk or a filler of fibre in addition to the thermoplastic.

Fig. 12-Fig. 14 are schematic cross section views of examples of the composition of the sheets. In the embodiment of Fig. 12 the sheets comprise a first layer 21, a second layer 22 and a third layer 23, wherein the first layer 21 and the third layer 23 are arranged on opposite sides of the second layer 22. The first layer 21 comprises, for example, polypropylene, the second layer 22 comprises, for example, polypropylene mixed with chalk and the third layer comprises, for example, polypropylene.

In reference to Fig. 13 the first layer 21' comprises polyethylene, the second layer 22' fibre or a mixture of plastic and fibre and the third layer 23' polypropylene.

In reference to Fig. 14 the first layer 21" comprises aluminium foil, the second layer 22" a mixture of polypropylene and chalk and the third layer 23" polypropylene. It is however clear that the number of layers and the composition of materials can be varied further and is not limited to the given examples.

Thermoplastic is a generic term for polyolefines, such as polypropylene and polyethylene. Chalk is a mineral sediment consisting of, for example, calcium carbonate, dolomite and/or talc. Chalk is a generic term for calcium carbonate, dolomite and/or talc. By choosing the composition of the material sheets in a suitable manner, different properties of the corrugated material are obtained. According to one embodiment the corrugated material can consist of only one optional material, such as for example plastic, fibre, aluminium or any other suitable material. In further one embodiment the material sheets can have different compositions to obtain specific properties. In yet another embodiment each of the material sheets can have different layers, each consisting of different materials, such as fibre, plastic, plastic/fibre, plastic/chalk.

The sheets of the corrugated material can be glued together in a conventional manner. Sheets of materials such as plastic or plastic compound can advantageously be melted or welded together without adding any adhesive in the form of glue or similar.

Fig. 15 is a schematic view of a device for manufacturing the corrugated product 10. The embodiment of Fig. 15 is suitable for manufacturing a corrugated product 10 of paper and/or fibre. The device comprises a first roll 24, such as a rubber roll, for abutment against a first plane sheet to be formed to a substantially plane sheet 11 having a regular elevation 16 between adjacent joining areas 15. The first plane sheet 11 runs over the first roll 24, which in turn brings the first sheet into contact with a second roll 25, such as a steel roll, under pressure. The second roll 25 is arranged with recesses 26 or indentations formed after the desired appearance of the first sheet 11. Thus, the shape of the recesses 26 corresponds to the shape of the regular elevations 16 of the substantially plane first sheet 11. By that the first roll firmly forces the first sheet 11 into the recesses 26 of the second roll 25 the corresponding shape of the first sheet 11 is obtained and maintained. Then, the first sheet 11 is brought to run along the second roll in the direction of arrow A.

The device further comprises a first corrugation roll 27 and a second corrugation roll 28 for corrugation of the second sheet 12. For example, the second sheet 12 is brought forward to the corrugation rolls 27, 28 via a guide roll 29 in a conventional manner. The corrugation rolls 27, 28 further comprise projecting portions 30 having suitable shape, which projecting portions 30 engages each other so that the second sheet 12 is shaped correspondingly. After shaping the second sheet 12 it is brought to run along the first corrugation roll 27 being in connection with a third roll 31 provided with glue, wherein glue is applied to the second sheet 12. Application of glue is obtained in a conventional manner, for example by means of a fourth roll 32 being partially lowered into a container 33 with glue so that glue is transported from the container 33 to the first corrugation roll 27 via the fourth roll 32 and the third roll 31. Then, the second sheet 12 is brought to run along the first corrugation roll in the direction of arrow B.

After forming the first sheet 11 and the second sheet 12, these are brought into contact with each other by that the second roll 25 is arranged in connection with the first corrugation roll 27. Hence, the second sheet 12 provided with glue is forced against the first sheet 11 and is joined therewith. For example, the substantially plane first sheet 11 is connected with the wave shaped second sheet 12 in the joining areas 15, wherein the regular elevations 16 between the joining areas 15 of the first sheet 11 are obtained. Thus, the speed of the second roll 25 and the first corrugation roll 27 is controlled so that points 34 of the second roll 25, i.e. the troughs of the first sheet 11, or portions projecting towards the wave shaped second sheet 12, are brought into contact with the tops 14 of the wave shaped second sheet 12. By this manner the sheets 11, 12 are glued together and the final corrugated material 10 according to the invention is obtained.

Additional sheets can be formed and applied correspondingly. If the sheets are substantially consisting of, for example, thermoplastics or compounds thereof they can be formed correspondingly, possibly with some modifications. It may, for example, be necessary to heat the sheet before

forming the elevations and possibly to cool the sheet after forming to maintain the shape of the outer sheet.